# *Headquarters U.S. Air Force*

*Integrity - Service - Excellence*

# Operational Energy Considerations

**June 14, 2010**

**Oliver Fritz**

**Directorate of Strategic Planning**
**HQ USAF/A8X**

Year of the Air Force Family

# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **14 JUN 2010** | | **00-00-2010 to 00-00-2010** |

| 4. TITLE AND SUBTITLE | 5a. CONTRACT NUMBER |
|---|---|
| **Operational Energy Considerations** | 5b. GRANT NUMBER |
| | 5c. PROGRAM ELEMENT NUMBER |
| 6. AUTHOR(S) | 5d. PROJECT NUMBER |
| | 5e. TASK NUMBER |
| | 5f. WORK UNIT NUMBER |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Headquarters U.S. Air Force (HQ USAF/A8X),Directorate of Strategic Planning,1060 Air Force Pentagon,Washington,DC,20330** | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | 10. SPONSOR/MONITOR'S ACRONYM(S) |
| | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) |

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release; distribution unlimited**

13. SUPPLEMENTARY NOTES
**Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 14-17 June 2010 in Denver, CO.**

14. ABSTRACT

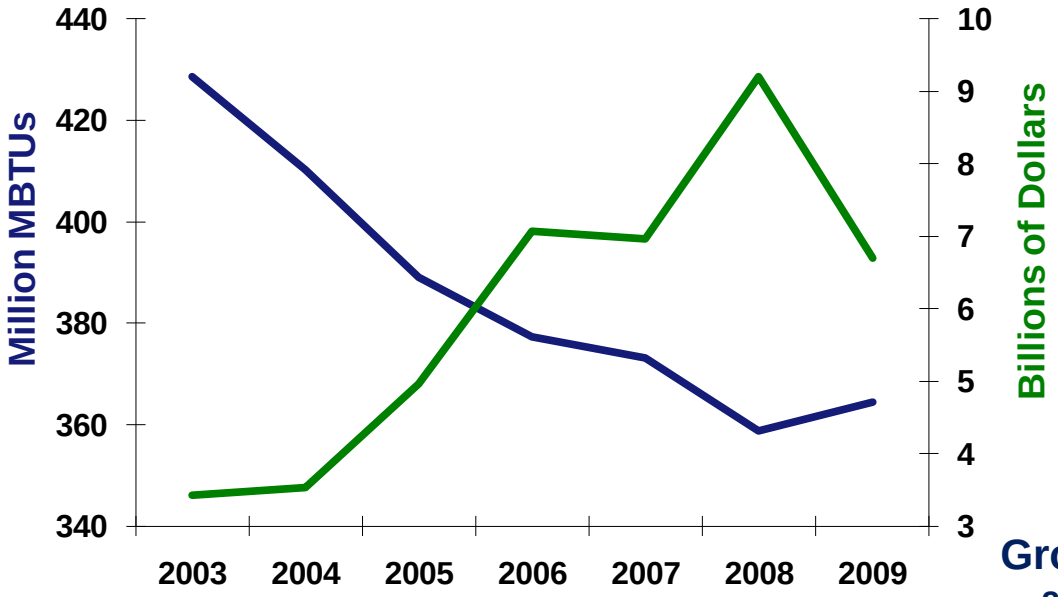
15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT **unclassified** | b. ABSTRACT **unclassified** | c. THIS PAGE **unclassified** | **Same as Report (SAR)** | **16** | |

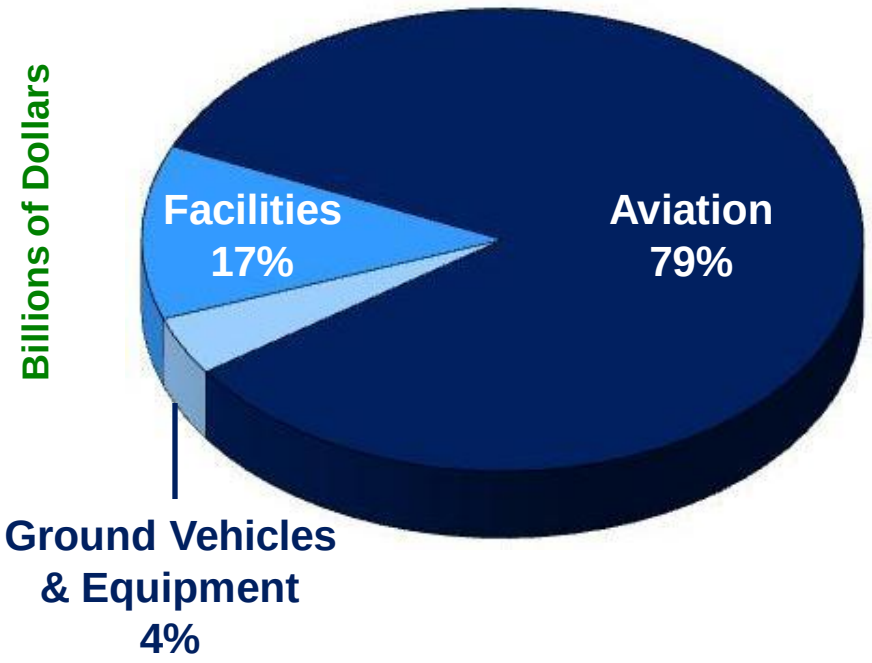
Year of the Air Force Family

# Background: AF Energy Demand in 2009

## Energy Cost and Consumption Trends




## Energy Cost Breakdown




***DoD is largest user in USG, AF is largest user in DoD…***
***Air Force spent $6.7 billion for energy in 2009***

Year of the Air Force Family

# *Need for Energy Creates Risk*

- **Strategic Risk**
  - **National reliance on fossil fuels from unfriendly regimes**
- **Fiscal Risk**
  - **Costs dependent on supply/demand for finite global commodity**
- **Operational Risk**
  - **Joint combat power reliant on lengthy energy supply chain**
  - **Disrupted energy supply decisively affects combat power**

***Even if energy was free of cost, still desirable to increase energy performance and decrease risk of disruption***

Year of the Air Force Family

# What is Operational Energy?

- Fueling Vigilance, Reach, Power
  - Intel, Surveillance and Reconnaissance
  - Rapid Global Mobility
  - Global Precision Attack
  - Air Superiority
  - Special Operations
- Powering the eagle's nest – expeditionary basing
  - Electrical power generation
  - Force protection

***Energy is responsible for Joint power projection***

Year of the Air Force Family

# Operational Energy: Old Risks…Made New

| Energy Supply Chain | Refining and Storage<br>Fields, Refineries, Terminals | Theater Deliv. and Storage<br>Ships, Pipelines, Tank Farms | Tactical Deliv. and Storage<br>Trucks, Tankers, Bladders | End Use<br>Aircraft, Generators, Vehicles |
|---|---|---|---|---|
| **Yesterday** | ▪ Ploesti,1943<br>▪ Syn fuel attacks, 1943-45<br>▪ Japan, SE Asia | ▪ Coaling stations<br>▪ Battle for Atlantic, 1941-45<br>▪ Afrika Corps, 1943<br>▪ Tanker War, 1980s | ▪ Patton's 3rd Army, 1944<br>▪ Advent of aerial refueling<br>▪ Airbase atks in S. Vietnam<br>▪ Cold War threats | |
| **Today** | ▪ Abqaiq, Saudi, 2006<br>▪ MEND, Nigeria | ▪ Piracy – Arabian Sea, Indian Ocean<br>▪ Terrorist Atks, Pakistan | ▪ Convoys via Pak, 'Stans<br>▪ IEDs, rockets, mortars<br>▪ No air, missile threats | |
| **Future** | ▪ Precision Mortars, Arty<br>▪ Ballistic, Cruise Missiles<br>▪ 5th Gen air | ▪ Precision Mortars, Arty<br>▪ Ballistic/cruise missiles<br>▪ Anti-ship missiles<br>▪ Quiet, diesel subs | ▪ Precision Mortars, Arty<br>▪ Ballistic/cruise missiles<br>▪ Surface to Air Missiles<br>▪ 5th Gen air | |

***"Airpower is a lightning bolt launched from an eggshell, invisibly tethered to a base"***

Year of the Air Force Family

# War Games Affirm Operational Energy Risk

- Futures Game 2009
  - Future ops dependent on high energy demand and robust theater logistics
  - Anti-access capabilities – ballistic missiles, subs, SOF, cyber – degraded BLUE logistics
  - Energy logistics and storage attacked
  - By last "move", energy began to limit air employment
- Navy's "Global 09" war game
  - Risk initially underappreciated – Seaborne and shore-based logistics
  - Complicated by force dispersion and could constrain maneuver
  - Force Protection requirements
- Similar risks exist in ground campaigns

***Reducing demand critical to reducing these operational risks***

Year of the Air Force Family

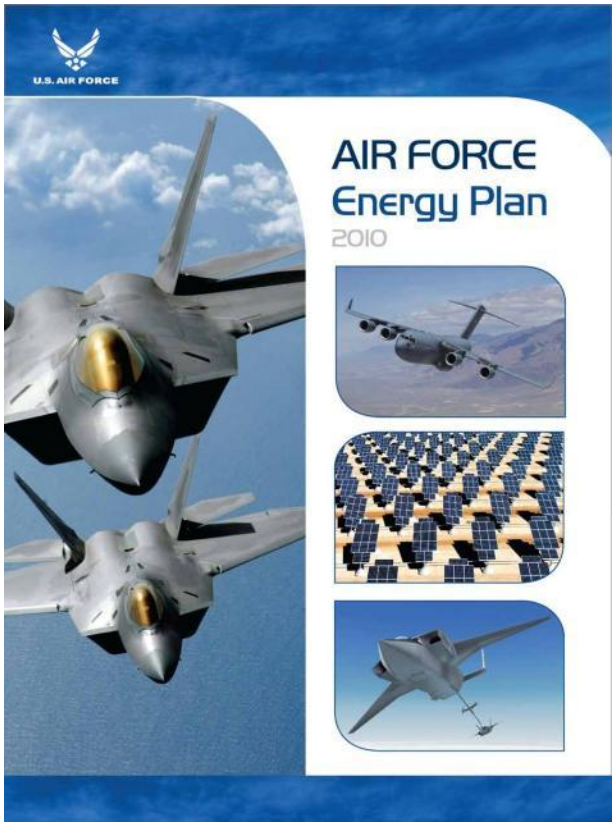
# Air Force Energy Plan: Enhancing Energy Performance

## 3-Part Strategy

***Reduce Demand***

***Increase Supply***

***Change the Culture***




**Vision**

***Make Energy A Consideration In All We Do***

Year of the Air Force Family

# Long-Term: Force Planning and R&D

- Integrate energy into force planning, requirements, acquisition
  - Energy in scenarios, war games, campaign models
  - Fully Burdened Cost of Fuel in Analyses of Alternatives
  - Energy Key Performance Parameter in acquisition
- Prioritize energy as focus area for R&D
  - Propulsion: Highly Efficient Embedded Turbine Engine, Adaptive Versatile Engine Technology
  - Design: Blended Wing Body
  - Materials: Composites, morphing structures

**"Upstream" planning and R&D should reflect role of energy performance in enhancing range, persistence, resilience**

Year of the Air Force Family

# Mid-Term: Upgrades and Modifications

- **Propulsion**
  - **C-130 T56 Series 3.5 upgrade: 7% savings, more time on wing; 7-year ROI; FY15 to FY22**
  - **KC-135 CFM 56-3 upgrade: 1.5% savings, more time on wing**
- **Subsystems: APUs, Actuators/Controls, Navigation**
- **Simulators and Distributed Mission Operations**

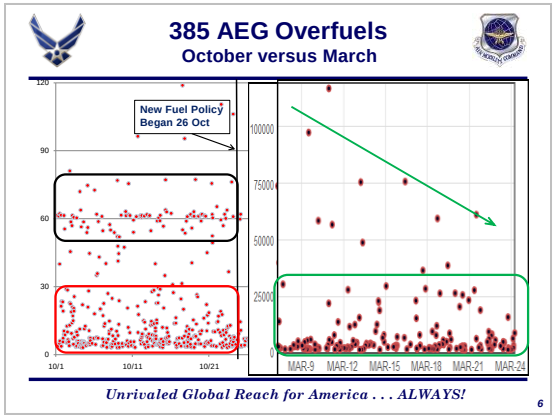
Year of the Air Force Family

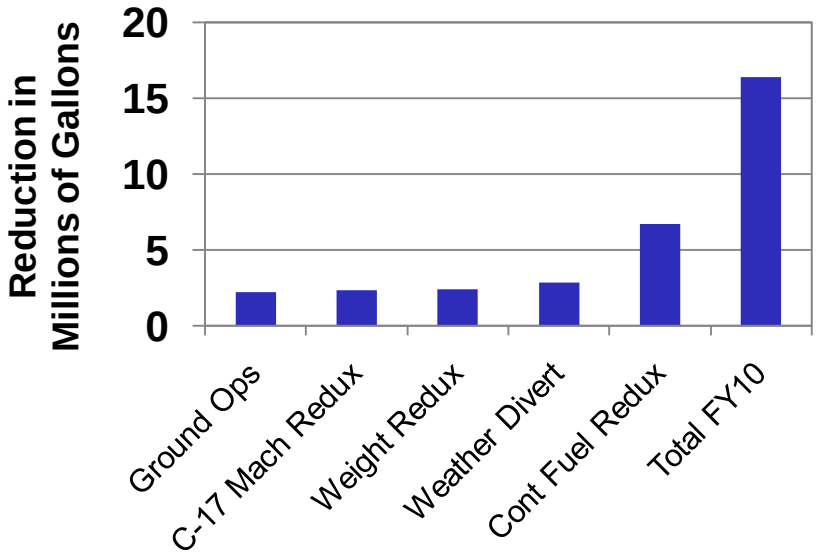
# Near-Term: Change the Way We Operate

- **Goal: Reduce aviation operations fuel demand by 10% by 2015**
- **Reduced aviation fuel consumption by 3% since FY06**
- **Major initiatives**
  - **Increase use of training simulators**
  - **Optimize air refueling practices**
  - **Reduce aircraft weight**
  - **Direct routing**
  - **Fuel efficient ground operations**
  - **Require accountability for fuel use**

# Case Study: Air Mobility Command

- **AMC reduced fuel use by 2.9% from 2006 to 2009**
  - **Verified C-17 "Ionized Water" wash, which resulted in increased fuel efficiency and $4.7M savings; justified plans to perform on all AMC aircraft**
  - **Conducted successful Altus AFB test of KC-135 radar pattern 'clean configuration', resulting in a 3.5% fuel savings during pattern operations (AETC test)**
  - **Reduced C-17, C-5, C-130 and KC-135 ramp loads to capture fuel savings; = 4.2M Gallons**




- **Implementing Web-based Fuel Tracker – Verification tool**

Year of the Air Force Family

# Summary: Risks and Opportunities

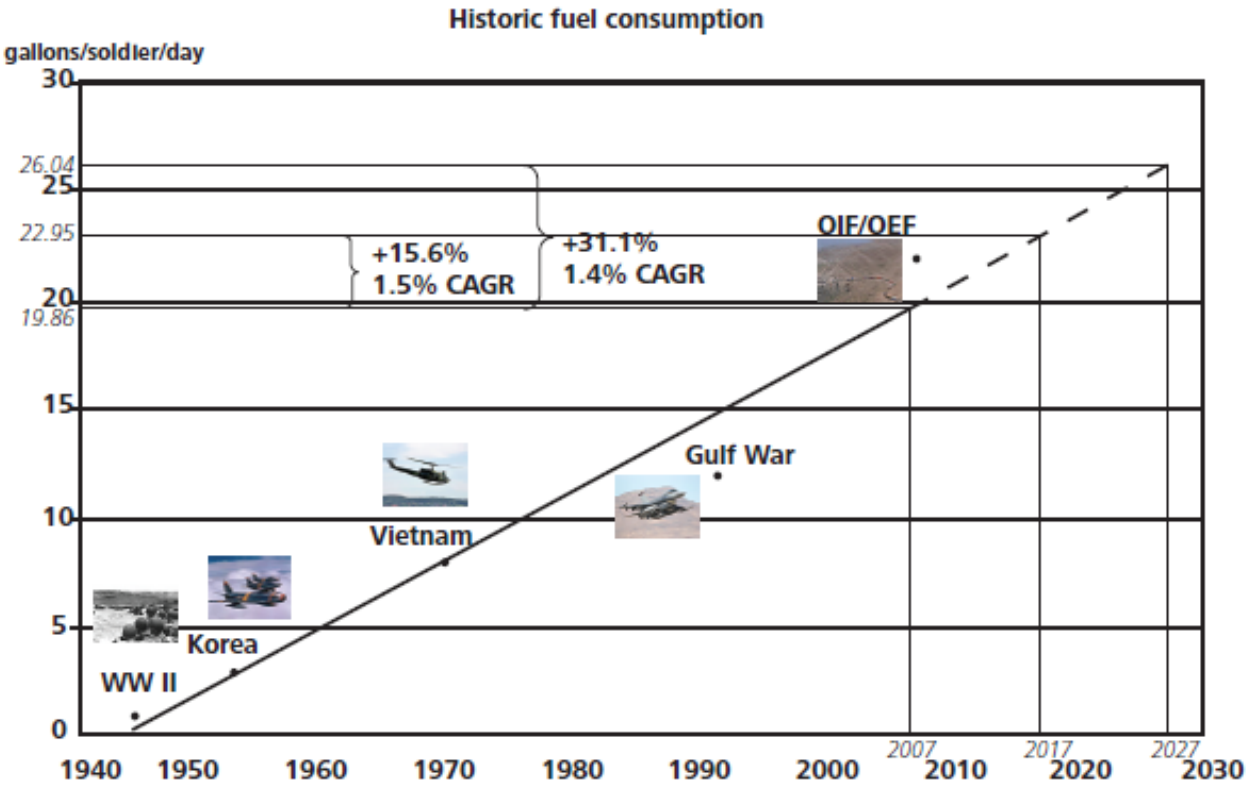
- Dependence on energy and threats to the commons may drive operational risk across the range of military operations
  - Increasing threats to energy supply chain
  - Experienced in current operations and affirmed in war games
- Air Force pursuing a range of policy, technological, and operational options to mitigate energy demand
- Not only about risk mitigation…about energy as force multiplier
  - Range
  - Persistence
  - Resilience
  - Advantage

Year of the Air Force
Family

# Questions?

# Fuel Consumption Increasing

**Chart 1: Historic U.S. Department of Defense (DoD) Fuel Consumption**




Source: DESC, Rand Corporation, AMSAA, Deloitte Analysis
Y=0.3091X-600.51. R-squared: 0.9517.

Year of the Air Force Family

# Air Mobility Fuel Facts

- Shaving one minute off of every MAF sortie (219,627 sorties in FY09) saves 142,838 barrels or 6.0M gallons of fuel annually ($16.9M)
- Eliminating overfuels by fueling every aircraft to precisely what is planned will save the MAF 114,762 barrels or 4.82M gallons of fuel annually ($13.6M)
- Reducing average APU use to from 2.1 to 1.5 hours per sortie will save the MAF 54,138 barrels or 2.2M gallons of fuel annually ($6.4M)
- Shaving one minute off of every MAF flight hour saves 538,904 barrels or 22.6M gallons of fuel annually ($63.8M)
- In 2009, the MAF consumed 49.1 barrels or 2,064 gallons of fuel every minute ($4,438 per minute)
- Removing 1 lb of excess weight from every MAF aircraft saves 108 barrels or 4,554 gallons of fuel annually ($12,800)
- In 2009, the MAF consumed 52% of all AF fuel and 28% of all DoD fuel
- In 2009, the MAF consumed 34.6M barrels or 1.45B gallons of fuel ($3.1B actual cost)

Year of the Air Force Family

# Why Consider Energy?

- Assured supplies of energy are fundamental to the Air Force – global vigilance, reach, and power depend on energy
  - Energy *is* operational access
- Future security environment will reduce likelihood of secure sanctuaries and lines of communication – at home and abroad
  - Attacks on Iraq/Afg supply lines already suggest strains on assured delivery of energy
  - Proliferating precision weapons – ballistic/cruise missiles, rockets, mortars, artillery – will increase threats to operating forces and fuel logistics across spectrum of conflict
  - Beyond kinetics, growing cyber threats to power generation and electrical grid
- Reducing operational risk from AF dependence on energy should be a consideration across planning, requirements, and acquisition
  - Reduce warfighting risk and meet Congressional/OSD mandates related to Fully Burdened Cost of Fuel